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ABSTRACT

The development of a HyperCard application program, "Connecting to Your MARS Account," is described. The program was intended to assist users of the biomedical computer system at the University of Pittsburgh (Pennsylvania), the Medical ARchival System (MARS), to connect to their computer accounts. Criteria from instructional, graphical, and message design were used. The criteria associated with instructional design were increasingly implemented as the project progressed. The complexity of the information involved required careful attention to readability and spacing in the screens and to graphical design. Message design concerns a deliberate problem-solving process, with an emphasis on perception, memory, concept learning, and attitude. The program was developed for HyperCard and will be evaluated. Initial trial tests indicate certain points of difficulty, but overall suitability for motivated users. The project continues with evaluative observations of users. (Contains 23 references.) (SLD)

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ED 363 314

Integrating Instructional, Graphical, and Message Design

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This project involved the development of a HyperCard application program entitled, *Connecting to Your MARS Account.* The purpose of the computer program was to assist users of the biomedical computer system at the University of Pittsburgh (MARS, ie., Medical ARchival System), to connect to their computer accounts through formats such as port entry or phone modem from Macintosh or PC computers. The program also aimed to facilitate uploading and downloading activities. Need for the program was identified from many requests for help in these areas by system users. A HyperCard based application program was selected for development because of its capacity to provide flexibility and ease of use as well as the rich mixing of text and images. In order to build a quality self instruction computer program, criteria from instructional, graphical and message design have been utilized. The criteria from instructional design included problem and task analysis; development of objectives, tests and strategies; building the prototype; evaluation and revision. The criteria from graphical design included composition in the areas of appeal, balance, innovation, information load, and inspiration. Graphical design also included attention to lettering in the areas of readability and spacing. The criteria from message design included attention to perception, memory, concept learning and attitude. These criteria were integrated increasingly as the project progressed. The criteria and distinct features associated with electronic text and images served as the basis for development of the evaluation research plan.

Background

For more than five years, electronic mail (email) has been available through the Medical ARchival System (MARS) at the University of Pittsburgh. Although email orientation classes have been provided regularly, as the number of users increased, the questions increased about various hardware and software combinations for connecting to the system. Sometimes users who had been to a class had new questions later when obtaining different hardware and software that could be used for electronic communication and transfer of files.To offer an option for users to learn in these areas, a computer tutorial was developed. Criteria from instructional, graphical and message design were used during the process. In the beginning, members of the development team used criteria tacitly as the criteria seemed to apply. However, explicitly identifying criteria soon became important as part of effective instructional product development. Since criteria are standards for making decisions, having explicit criteria helped to clarify the foundation from which the rest of the work could proceed consistently and rigouously.

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Instructional Design

Overview of the Instructional Design Process

Instructional design is a plan for instruction that aims to bring about effective learning outcomes. To do this, the learners, what is to be learned and the conditions within the learning situation need to be assessed. Numerous scholars in fields such as education, psychology, and information science, have examined components of instructional design (Banathy, 1968; Briggs, 1970; Gagne, 1970; Henson & Knezek, 1991; Jonassen & Hannum, 1986; Seels & Glasgow, 1990; Tripp, 1991; Vockell, 1990).

Criteria. The following criteria reflect a synthesis of the above works. They evolved during the planning work of this project and are considered necessary inclusions for decision making when developing an instructional computer program.

1. Analysis of Problem - Analysis of the problem is ongoing throughout the design, development and testing of the program. Initial and ongoing analysis of problems is accomplished by the project team. Analysis means examining the parts of the project related to the whole of it. Problems mean questions requiring ideas and actions to answer the questions. The analysis has a purpose to observe features and functions of the parts and to note how the parts relate to each other merging toward a common goal: an effective computer program.

2. Analysis of Tasks - Activities of importance in a task analysis include to: a) analyze behavior to be taught; b) seek information sources to support the analysis; c) plan data collection instruments and procedures; e) review task analysis with project team members. An algorithm may be developed to provide a roadmap regarding the analysis of tasks. This roadmap could help project developers in making decisions in areas such as scope of learning or analytic method to be applied.

3. Development of Objectives, Instruments and Tests - In developing objectives and tests, the team includes these activities: a) determine complete objectives in cognitive, affective and psychomotor domains; b) determine the conditions and criteria for attainment of the objectives; c) determine the types of instruments and tests; d) construct, trial test and revise the instruments and tests. In the present project, the test planned required the learner to demonstrate an ability to use email and to transfer a file through MARS.

4. Development of Strategies for Self Instruction - These activities include: a) develop effective introductions to what is to be learned; b) present new material in a number of ways; c) link abstract to more concrete information; c) provide a choice of realistic practices; d) incorporate planning and problem solving elements; e) make provisions for motivational and corrective feedback. In addition to use of these strategies, provide an estimation to the learner about how long it should take to go through the program.

5. Selection of Instructional Media - During media selection the project team work through these actions: a) identify desired channel(s) for input of information; b) analyze the learning situation; c) analyze constraints and resources; d) determine type of media such as print, projected or interactive; e) determine if product already exists or needs to be developed. In this case the interactive feature was recognized as essential and since no product existed that would do the job that was wanted, development of the computer program was identified as necessary.

6. Development of Prototype - Use of a prototype method was considered important to arrive at a quality instructional computer program. Prototype software is a fully functioning piece of software with the desired features. Ongoing trial tests of the program are expected in an iterative

process and a number of versions are expected to emerge, each with improvements. A self instruction computer program prototype was viewed as including: a) title; b) directions for use; c) objectives; d) instructional sequencing or patterning with branching; e) arranged choices; f) examples; g) combination of graphics and text; h) summary. Additional aspects to be considered included a glossary, references and a posttest.

7. Use of Evaluation Research Methods - Knowing the effectiveness of an instructional computer program is not possible without testing its effects with learners. Therefore, a plan was devised to trial test the program with a variety of learners at different levels of background knowledge having to do with electronic communication and information systems. It was expected that a number of revisions would be made as test users worked with the program.

Summary. The criteria associated with instructional design have been increasingly implemented as this project has progressed. Their identification has created greater consistency among the project team in understanding the goals of the project and how to reach the goals. As the criteria involving instructional design have been worked with, it has become apparent that graphical design has also a major role in an instructional computer program.

Graphical Design

Overview of Graphical Design

Graphical design refers to the planned use of strategies to enhance visual communication through pictorial and text images. Greater unity of a basic idea can result from effective use of graphical design criteria. This capability to achieve visual unity can facilitate the viewer's understanding of the idea being conveyed.

Criteria. The graphical design criteria in this project included an emphasis on composition, readability and spacing. These criteria are described as follows:

1. Composition - The total picture impresses the viewer. The viewer scans in such a way that information needed to understand the meaning of the visual, is input conveniently. Within the composition the designer works to provide a) appeal; b) balance; c) innovation; d) optimal information load; and e) inspiration for the viewer. Appeal refers to those features that attract the attention of the viewer. If attention is not gained, learning will be impeded. Balance means that an esthetically pleasing effect has been achieved in the distribution of elements of the graphic. A balanced graphic offers stability. The learner begins to recognize patterns. These patterns serve as cues for the interactivity involved in using a computer program and also may assist retention of the content. The learner is assisted to focus on key content through a succession of visual cues (Dwyer, 1978).

While balance is helpful for stable effects, innovativeness is also incorporated to sharpen viewer alertness and interest. When the project staff can be freely creative during the early developmental period of product development, the result is likely to be more of an innovative product (Couch & Miller, 1990). This does not imply a lack of boundaries but it does mean that different forms of design strategies are encouraged.

In addition to appeal, balance and innovation, the information load needs to be considered. If too much information is on a screen at one time, the learner may become confused and not be able to interact. Finally, composition also includes attention to inspirational qualities offered on the screen. Inspirational qualities help to energize the learner.

Each of the compositional elements/qualities were designed into the present computer program. Examples include: a) Appeal was incorporated in the title screen. Spheres were depicted that helped guide attention much as a bullseye draws attention. b) Balance was used on the main screen that gave a menu for getting into the main content areas of the

program c) Innovativeness in the present project could be seen in the screens that were designed with one ragged edge to indicate it was a portion of a bigger screen d) Information load was analyzed by all of the development team with the understanding that one basic and unified idea would be conveyed by each screen. The main menu screen was in three sections, equally balanced with information representing choices for interaction. The text was developed to be as succinct as possible so the viewer could scan each choice easily and quickly e) To inspire the learner, several learning objectives were listed at the beginning of the program. A summary of content was developed on one of the last screens as a reminder of what had preceded and as a way for the learner to check what had been learned The criterion of composition relates closely to two other graphical criteria of readability and spacing.

2. Readability - To make sense of the screens of a computer program, the screens need to be developed to be read easily. This means that new terms should stand out and perhaps be defined in a help section. Not only does text material offer readability, but so does the pictorial graphic. The icons or other non text symbols permit associations to enhance understanding of the content. Careful efforts need to be made so the pictorial graphics are not misread. This is where it is very helpful for the project team members to check with each other to validate the accuracy of interpreting the graphics. If doubt exists about their interpretation, then a panel of external experts should be consulted to provide interpretations. A discussion of their responses would help the developers decide on the actual graphics to be used.

3. Spacing - Spacing promotes readability because it makes possible the clear identification of each picture graphic or word of text. When a screen is overly crowded with not enough space around each graphic point, reading becomes difficult. Information may be misunderstood. When confronted by a series of cluttered screens, the learner may even give up in disgust. Trying to understand crowded or cluttered screens can be difficult, time consuming and wearing on the learner.

Summary. The complexity of information involved in instructing a person about electronic mail and up and downloading files requires that screens undergo careful composition with attention to readability and spacing. If the screens are not designed graphically to achieve perceptual coherence, that is unity, the elements are perceived as separately isolated entities (Osborne, 1986). This is different than intended for the learner. The learner would find it difficult to conceptualize and categorize as is done to establish accurate meanings. Today, increasing attention is being given to the capability of graphics to facilitate conceptual reasoning. For example, conceptual finding graphs have been developed to promote organization and storage of descriptive content into computer databases (Bernauer, 1992). Through conceptual finding graphs, categories of information may be communicated more clearly. Enabling communications in an instructional computer program also involves message design criteria.

Message Design

Overview of Message Design

Message design concerns a deliberate problem solving process involved in communication and the words and picture elements used to produce that communication. When the message is designed for instruction, the purpose is to influence or change the cognitive, affective or psychomotor behavior of individuals.

Criteria. The following criteria related to instructional message design include an emphasis on perception, memory, concept learning and attitude (Fleming & Levie, 1978; Mager, 1968).

1. Perception - When visual information is presented in an organized way, perception

is enhanced. During perception, a person tends to group what is seen and tries to construct relationships between the parts identified in the view. For example, a figure in the foreground is differentiated from the background. Text on a computer screen is differentiated from the background of the screen. Recognizing that persons come from different experiences, and that perceptions can vary, computer program developers need to be very clear about any messages planned for the screen. Technical terms may not be fully understood, therefore a help glossary, descriptive succinct statements, and use of common terms may each help the learner correctly perceive the content of the program. An additional way the content of the HyperCard application program is organized to assist perception is by the numbers on successive screens to reflect location in a stack of cards. For example, card 1 of 4, card 2 of 7, and so forth.

2. Memory - When a person understands the meaning of messages presented, the information can be retained better. As messages or parts of messages are repeated, practice in thinking and remembering are facilitated. On a computer screen if the same prompt symbol is always shown when in the email mode, then the person has a number of opportunities to practice and remember that prompt symbol and to associate it with being in email.

3. Concept Learning - A concept is a mental image of a phenomen and can vary in abstractness. In terms of language use, a concept is thought of as an umbrella term under which similar items may be grouped. Critical attributes are used to more clearly define a concept. If one or more of the critical attributes is absent, then it is not the concept in its exact form (Walker & Avant, 1988). The use of examples helps to demonstrate the presence of a concept. As an illustration, in the computer program, in one screen the learner is presented information about baud rate. At the left of the screen 2400 baud rate is highlighted. In the text at the right is stated "2400 in this example."

4. Attitude - Although attitude is internal , consistent patterns of behavior are thought to give a clue about a person's attitude. A designed message holds the potential to influence or change attitude. This change has been associated with the perceived credibility and attractiveness of the source information. The developers of the computer program wanted to instill confidence in working with email and electronic transfer of files. It was reasoned that having a confident attitude toward performing these activities on the computer would promote use. Successful experiences on the computer during increased uses would provide positive feedback to the person, thereby increasing confidence again. The job for the developers was to put together an interesting program with positive experiences during interactivity with the program, thereby fostering the positive feedback cycle.

Summary. Message design criteria work hand in hand with instructional design criteria. Throughout instructional segments, the learner receives designed messages emphasizing an organization to the information in order to promote perception and memory, examples reflecting concepts, and positive yet correcting feedback cycles to influence attitude. Because these criteria incorporate pictures and text in the communications, graphical criteria are also naturally interwoven in the process.

Electronic Text and Images

Features

The electronic learning environment offers numerous opportunities for the learner to interact while using a program. This interaction comes under the control of the learner who can work rapidly or slowly, all at one time or in successive time periods, and exposed to a few branches or many (Jonassen,

1988). The project development staff working on the actual computer program tap into this electronic capability as instructional segments are prepared for the learner.

Controlled Access

Having control over the access of the content permits the learner to explore freely; to get into selected areas of interest and to avoid areas that are not desired. Time is a valuable commodity and having controlled access allows the learner to spend as much time as needed with the content at a time that is convenient. If the computer program can be used online, then the time factor would be further enhanced, especially for persons living a distance who gain access from remote sites. At the present time the project described here is accessed off line at individual microcomputers.

Interaction with Text and Pictorial Images

When a program has the rich mix of pictorial graphics and text, the learner has choices with which to interact. In addition, many of the choices can serve as visual cues to enhance recall for interactions at a later time. For a learner who has mostly used a receptive style of learning, when exposed to the high degree of interactivity that the computer program offers, may need time to become oriented to the interactive learning environment.

Diverse Structures

Structural components of a computer program begin with the initial plan for instruction and the decision points anticipated for the learner. Logic is incorporated into this plan. For example if the learner needs to have a technical term defined, then a sub-window can be made available for the learner to choose to see a definition. A multitude of interconnections are provided in the program so that a learner can move about the program easily from beginning to end, from main menu to several menus later and so forth.

Symbol Richness

A rich array of symbols is designed with purpose onto the screens of the computer program. Examples of symbols would be numbers, letters, glyphs or pictures and these symbols become representations of an occurrence or condition understood as the real world. To illustrate the program included a visual orientation to locate the user within the program; Card 1 of 5, Card 2 of 5, and so forth. The symbols are part of an overall learning environment that lead to rule making for data, awareness of information, and insight toward knowledge and wisdom (Debons, Horne & Cronenweth, 1988).

Use of HyperCard to Develop an Application Program

Overview of HyperCard

HyperCard, developed by Bill Atkinson, is an authoring tool that serves as a way to organize information (Goodman, 1987). It is used when an application program is wanted that needs organization and flexibility. HyperCard offers the ability to create stacks of information that can be retrieved as needed. It is also possible for the learner to move to other stacks by going to a central point in the program. HyperCard, operating in a Macintosh environment, has had many different types of application programs developed. A few examples of particular interest in the health fields include programs reported by Furman (1992), Rathe (1992), and Vinik, Sirman, Georges and Phillips (1992).

Description of Application Program Development

After an initial set of meetings of the developers of this project, the need was identified for the development of the HyperCard program to enhance email and file transfer knowledge of users of the MARS system. Over a period of a year the program was developed using the criteria

discussed above. At several points, the program was tried out by the team to critically determine needs for revisions. In addition to checks by the project team, several trial tests with learners at varied levels of computer knowledge have been carried out. A documentation book has been developed to serve as a visual roadmap into the program. It consists of many of the actual screens that the learner would see in using the program.

Use of Evaluation Research Methods

Evaluation research is a next step associated with instructional design. The purpose of the evaluation component is to gain useful information about the effectiveness of the program to assist persons to learn in the targeted areas. Since the program should eventually be used alone by persons in a self learning mode, evaluations need to include observations of the use of the program as they occur naturally. Therefore, observations were made as individuals used the program for the first time. Three persons were observed individually. One person reported having beginning knowledge and skills on the computer and two persons reported having intermediate knowledge and skills. Two members of the project team made the observations and could independently conduct a content analysis of the field notes taken to be followed with a validation of themes through discussion.

The findings from the beginning trial tests of this program include these aspects: a) Learners may be puzzled or frustrated at certain points through the program, but they find it interesting and are motivated to continue because they want to use email and/or to transfer files. b) Besides content that will help learners understand the broader picture in using electronic systems, learners are interested in system specific information, that is, the information that will help them use their own computer configurations. c) After going through the program, the learners at both levels were better prepared to ask questions to further their ability to get on the system with their individual computer configurations. d) Each of the learners expressed the value of being able to use the program and the possible need to review it a later time. e) Transfer of files was of greater interest to learners who had more prior computer knowledge. In addition to these findings, the team also identified need for some sequencing changes in the screens and a few editorial revisions.

Summary

This project represents a combined effort among persons from different disciplines who pooled their knowledge in an attempt to solve an identified instructional problem. In working on the project the team recognized the importance of using criteria from work in instructional, graphical and message design. These bodies of knowledge when combined serve as a rich foundation from which to work creatively to develop a quality product. Evaluation research can help to reveal the effectiveness of their presence. The added features of an electronic environment such as controlled access and the abundance of interactivity suggest many possibilities for further research. This project will continue the evaluative observations of users in an attempt to gain greater understanding of the learning aspects of the program. This will help with decisions in planning other programs in the future.

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